Observations on the Mating and Oviposition of two land Pulmonates, *Achatina fulica* Bowdich and *Macrochlamys indica* Godwin-Austen

BY

KRISHNA CHANDRA GHOSE

Department of Zoology, City College, Calcutta

INTRODUCTION

Considerable diversity is encountered in the number of eggs produced by gastropods. On one side of the range stands *Doris* producing 600,000 eggs in one brood (Kroschelt & Heider, 1900), and on the other *Macrochlamys indica* and *Nassa* producing only 2 and 5 eggs respectively (Kroschelt & Heider, 1900). A relationship exists between the number of eggs laid and their size. The amount of albumen present in the egg has a direct bearing on the developmental period of an animal. A large amount of yolk is essential for the development of those where free larval stages are absent, and consequently the large size of the eggs has led to a proportionate reduction in the number of eggs produced by an individual. In addition there appears to be a correlation between the total volume of the eggs produced in one year and the size of the animal.

OBSERVATIONS

After a long period of aestivation (November to June) the snails become active with the coming of the rains. In the first few weeks they are less active and remain busy in search of food. Egg-laying usually commences when the monsoon is fairly advanced, i.e. towards the end of July to the beginning of September. Mating, though not essential for reproduction, has been described by the previous workers (Meer Mohr, 1949; Mead, 1950; Balasubramaniam, 1952; and Rensch, 1955) to be a common feature. During mating two individuals come side by side in such a manner that their genital apertures are apposed. The intromittent organ of one comes out through the genital aperture and is pushed into the vagina of the other and vice-versa. Mating is said to last for a variable period,[1] after which the intromittent

[1] About 1½ to 2 hours in *A. fulica* (Meer Mohr, 1949) and 45 minutes in *M. pedina* (Rensch, 1955).

organ is withdrawn and the animals separate. Sperms received by the partners in the act are stored in the spermathecae for subsequent fertilization of the ova.

The present author could not observe mating in these snails in spite of continued observation both during the day and in the night in caged specimens as well as in specimens in their natural habitats. In a heavily populated area, they are often found to embrace each other, and this may be mistaken as a case of mating. In certain cases, an intromittent organ was seen to protrude through the genital aperture, but no tendencies of mating were observed. The protruded organ is conical with a swollen base and bears a narrow genital pore at the tip.

During the breeding season the reproductive organs of nearly fifty snails of each species were dissected. The specimens taken were of different stages in relation to oviposition. Some of them were taken before, some during, and others after oviposition. Sperms were found both in the spermathecae and the uteri of several *M. indica* and only one *A. fulica.* The snails are protandrous, sperms develop prior to ova, and the ovotestis duct with the ovisperm vesicle remain packed with living sperms throughout the year, a state which continues during the whole life. While coming down from the ovotestis the ova are likely to be fertilized in the basal ovotestis duct since they have to pass through the swarms of sperms, and it is very difficult to conceive how the mature ova may come down unfertilized.

Embryos in different stages, from the zygote to many cell stage in *A. fulica* but only in the zygote stage in *M. indica,* are found in the eggs taken out from the apex of the apical uterus. The sperms cannot penetrate the egg membrane and, if cross-fertilization is to be effected in such cases, the sperms from some other snail must at least reach the apex of the apical uterus. In no case were degenerating sperms found in the albumen mass of the egg. The absence of sperms in the uterus is a normal feature, and it appears that self-fertilization is a common mode of reproduction in *A. fulica,* while both cross- and self-fertilization are normal in *M. indica.*

To ascertain if self-fertilization is a common mode of reproduction in them several snails were separated from the early stages (15 mm.) and reared with special precaution. Normal young snails hatched out from the eggs laid by these isolated individuals on attaining sexual maturity. Separation at early stages rules out even the remotest possibility of fertilization by the sperms received in the previous year; though the survival of sperms for a whole year in the genitalia of another individual is not expected.

The eggs are laid in batches in small holes made in damp soil by

the snail with the help of the snout and the anterior end of the foot. Oviposition usually takes place towards the evening or in the night though laying during daytime is not rare. The eggs are dropped one after another in the hole along with a profuse quantity of a slimy substance discharged through the genital aperture. Laying continues for about two hours in *A. fulica*, the period depending on the number of eggs which varies extremely. The known record in a single brood is minimum 82, maximum 315 in Sumatra (Meer Mohr, 1949) and 120 in Kenya (Rees, 1950). The present author found the number varying from 27 to 356, the average being 200. The colour of the eggshell varies from light to deep yellow, but white ones are not very rare. It is calcareous, porous, tough, and thick, needing considerable pressure to break. A non-separable shell membrane is present in most cases just inside the shell. The laying of eggs without any eggshell is not rare, and these eggs contain normal developing embryos. The number of eggs in one brood of *M. indica* varies from 2 to 35, the average being 14. The outer egg cover is smooth, tough, elastic, and translucent white in colour.

The shape and size of the eggs in *A. fulica* are also variable. Usually they are broadly ellipsoid, but a few round ones are also sometimes found. Meer Mohr (1949) found the average size 5.4×4.28 mm. and Rees (1950) 7.1×5.6 mm. In the eggs collected by the author the average maximum size is 5.5×4 mm.; and the average minimum is 3.5×3 mm. Several small eggs are found in almost every brood, and the snails to hatch out last are always from these small eggs. In *M. indica* the eggs are always round and the size varies from 1.7 to 3 mm., the former being only a few and only in some of the broods.

The eggs are covered with a thin film of mucus, which absorbs water from the surrounding damp soil and protects the eggshell from drying up. The embryos in eggs freed of mucus or removed from their damp surroundings do not hatch out. On dissection it was found that in such eggs the albumen dries up quickly and the embryos cannot develop further. The eggshells of *A. fulica* exposed to sunlight or dry air crack with a sharp click, audible from a distance of several feet. If removed from their damp surroundings the eggs of *M. indica* shrivel up due to loss of water, but they regain their normal shape and size once more if placed in contact with moist substance.

The colour and viscosity of the albumen vary considerably. The former ranges from colourless to deep yellow, and the latter from very fluid to thick state in *A. fulica.* The albumen is always very fluid and colourless in *M. indica.*

The stages of the embryos at which the eggs are laid are extremely variable in the different species. Embryos earlier to the formation of the heart (3 mm.) were rare in *A. fulica* and they were in the segmentation stage in *M. indica.* In a high percentage of cases, the embryos are found in fairly advanced stages at the time of laying and hatch out from the eggs within a day or two in *A. fulica.* Laying of eggs with very early stages of embryos is rare, and in such cases the embryos usually fail to develop. Attempts were made to obtain young snails from the eggs with very early embryos taken out by dissection of the uterus, but these were almost always infructuous. It appears that the *A. fulica* has progressed considerably towards the attainment of ovo-viviparity while *M. indica* lags far behind. The percentage of hatching in the eggs laid with late embryos is very high.

In general, it can be said that in *A. fulica,* the smaller or whiter the eggs the earlier will be the stages of embryos in them. Again, the larger and more yellowish the eggs the more advanced will be the developing embryos. No such generalisation is possible in *M. indica.*

The snails begin to lay eggs at the end of their first year. The minimum size[1], at which *A. fulica* and *M. indica* have been noted to lay eggs is 59×27 mm. and 12×8 mm. respectively (*A. fulica* bred and reared in the laboratory reached 67×34 mm. in eight months). Under no circumstances a single individual *A. fulica* laid eggs more than once in a year[2] though several broods per year are common from one *M. indica.* The number of eggs laid by an *A. fulica* in the first year of its sexual maturity is the minimum; the number gradually increases with age and is again on the decline from the fourth or fifth year, but never comes down so low as in the beginning.

Various attempts[3] to induce *Achatina* to lay eggs throughout the year met with partial success only. The earliest date of egg-laying in a caged specimen was 24th March and the latest was 29th September. *M. indica* could be induced to lay eggs throughout the year by keeping them active artificially and supplying their favourite food lavishly.

---

[1] 60 mm. (Meer Mohr, 1949).

[2] Meer Mohr (1949) states that several batches of eggs are laid by an individual in one breeding season.

[3] (*a*) The humidity of the rearing chambers was controlled, and the snails were kept active throughout the year.
(*b*) Snails were awakened from aestivation by spraying of water, and the same repeated at regular intervals to keep them active.
(*c*) Fresh specimens, collected after showers, were kept active by the above processes, and some of them were released in chambers with active residents.
(*d*) A liberal supply of favourite food was maintained.

The snail waits for a few hours by the side of the eggs after the completion of laying. This may be due to partial exhaustion of the animal in the process of oviposition. After recovery, it slowly moves away from the eggs, never to turn back again. In a few cases, the snail has been noted to cover its eggs with foreign matter, like leaves or the soil pushed from the sides of the hole. Incubation by the parent is totally absent.

Table showing particulars of eggs laid in different years

Species	Year	No. of broods	Total no. of eggs	Average no. per brood	Total no. of small eggs	Percentage of small eggs	No. of broods with early embryos	No. of broods with somewhat advanced embryos	No. of broods with fully advanced embryos
A. fulica :									
	1951	4	1024	256	24	2.3	1	1	2
	1952	16	3092	193.25	75	2.4	3	3	10
	1953	15	2196	146.4	61	2.8	3	5	7
Total ..		35	6312	180.34	160	2.53	7	9	19
M. indica :									
	1951	15	251	16.7	40	15.9	4	9	2
	1952	30	385	12.8	74	19.5	6	20	4
	1953	25	341	13.6	42	12.3	6	16	3
Total ...		70	977	14.0	156	16.0	16	45	9

References

Bahl, K. N. (1928): On the reproductive process and development of *Pila globosa* (Swainson). *Mem. Ind. Mus.* **9**: 1-11.

Balasubramaniam, T. S. (1952): Development of *Ariophanta bristrialis* Beck. *J. Anam. Univ.* **17**: 94-100.

Kroschelt, E. & Heider, K. (1900): Textbook of Embryology of Invertebrates **4**:102.

Meer Mohr, J. C. Van der. (1949): On the reproductive capacity of the African or Giant snail, *Achatina fulica* (Fér.). *Treubia* **20** (1): 1-10.

Rees, W. J. (1950): The Giant African snail. *Proc. Zool. Soc. Lond.* **120** (3): 577-98.

Rensch, L. (1955): On some Indian Land snails. *JBNHS* **53** (2): 163-176.